

Alien species Invasion

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The Dataset

The data pertains to invasions by alien insect species proposed by M. Boschi et al. (2023), which includes supplementary datasets including regions of origin, average regional temperatures, trading and distances between regions. The dataset records the first occurrences of alien insect species invasions. In case of multiple native regions for a species it has been chosen only one. The aim of the analysis is to investigate the impact of some of the covariates on yearly rates of the phenomenon.

Relational Event Models

Relational event $e = (t, s, r) \Leftrightarrow$ sender s interacts with receiver r at time t . It's then a counting process. Can be modelled through its intensity:

$$\lambda_{sr}(t) = Y_{sr}(t) \lambda_0(t) e^{\beta^\top x_{sr}(t)}$$

AIM: To give an estimate of β .

- No simultaneous events.
- Interaction rate between s and r is linearly dependent on the covariates

Partial Likelihood

For parameter estimation was used:

$$L_p(\beta) = \prod_{i=1}^n \left(\frac{\exp \left(\sum_{k=1}^q \beta_k x_{s_i r_i k}(t_i) - x_{s_i^* r_i^* k}(t_i) \right)}{1 + \exp \left(\sum_{k=1}^q \beta_k (x_{s_i r_i k}(t_i) - x_{s_i^* r_i^* k}(t_i)) \right)} \right)$$

Generalized Additive Models

The response variable's relationship with predictor variables is expressed through smooth functions as per Hastie et al. (1990).

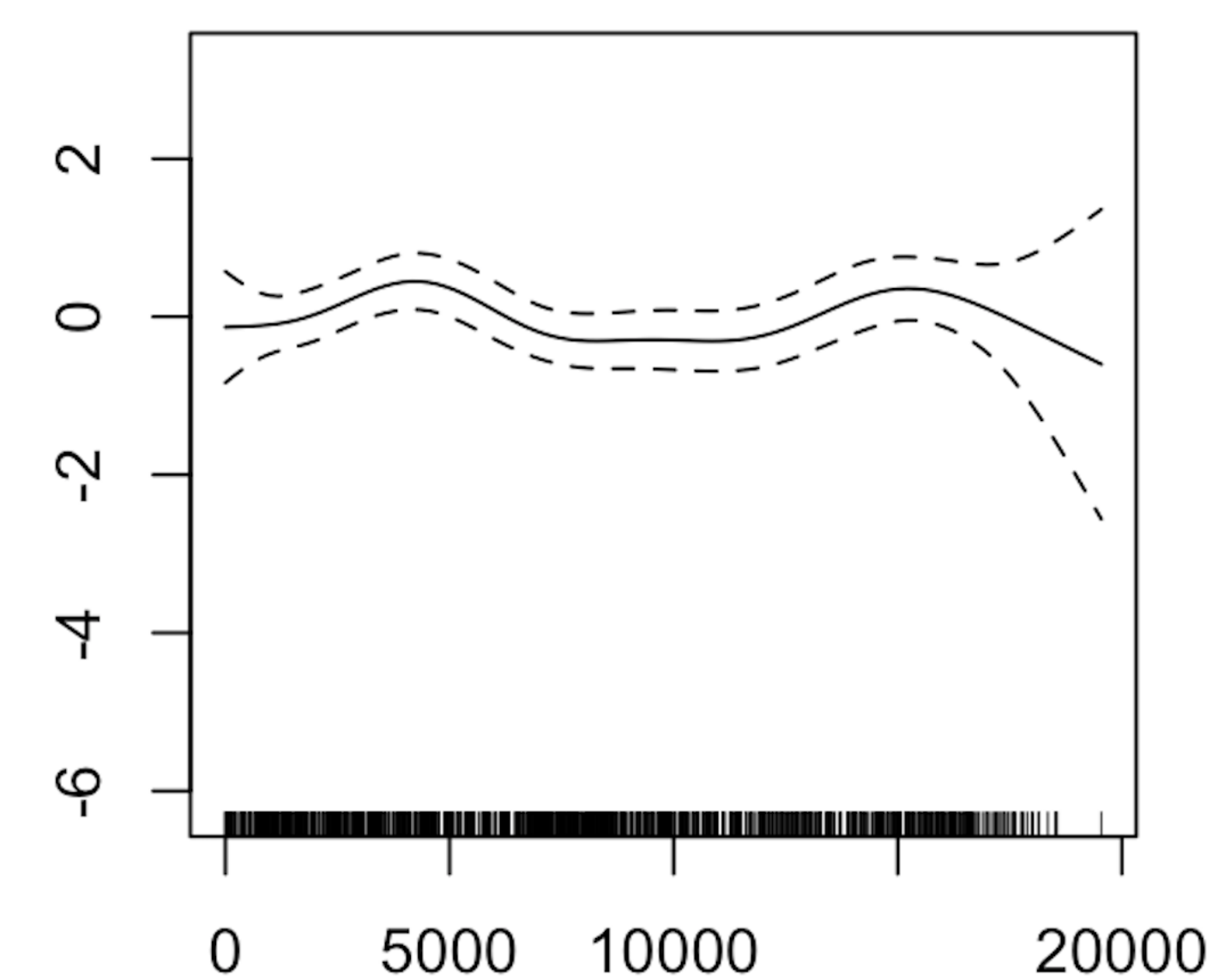
$$g(E(Y)) = \beta_0 + f_1(x_1) + f_2(x_2) + \dots + f_m(x_m).$$

- The distribution from the exponential family chosen was Binomial

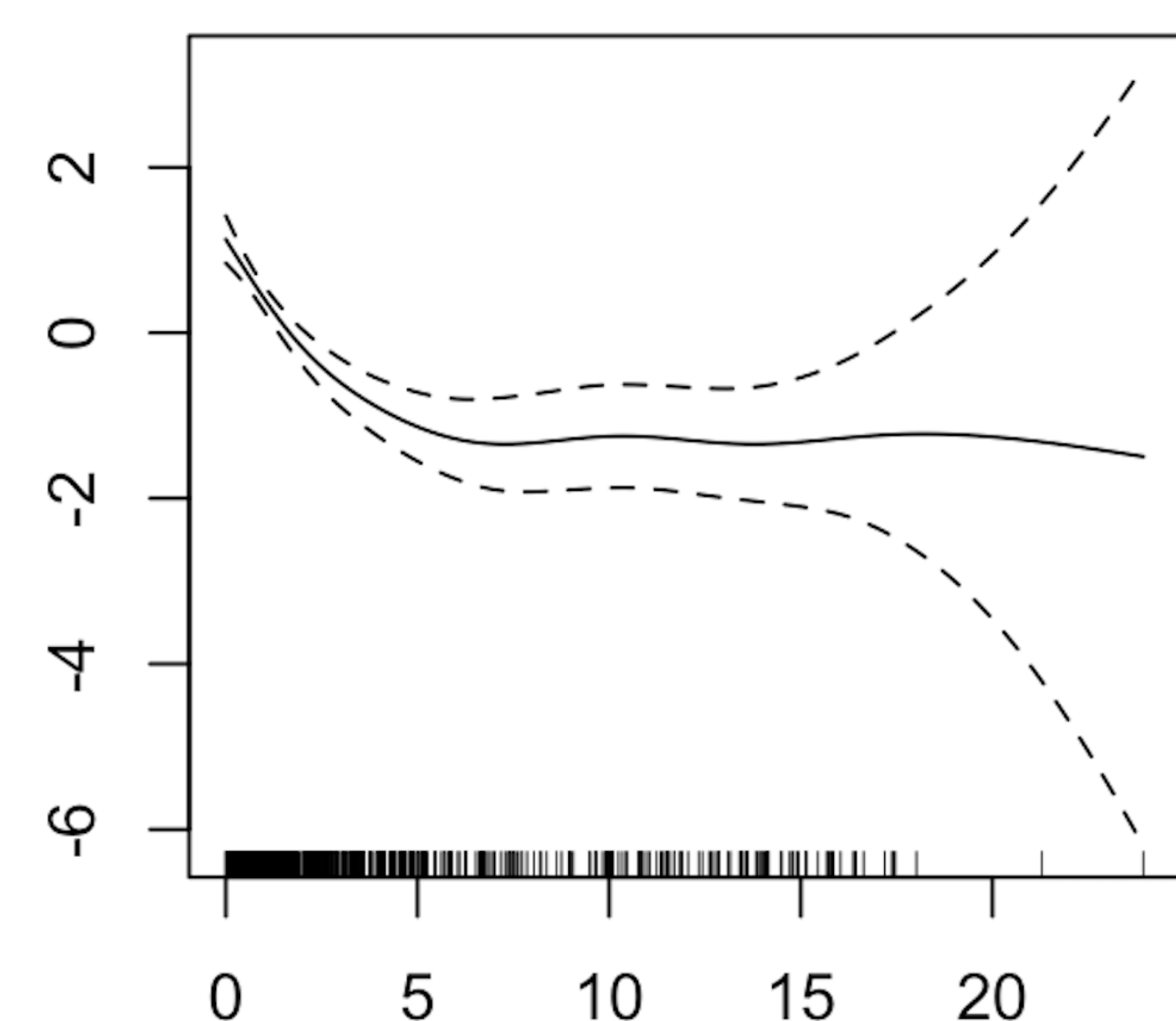
Covariates

- Distance of the invaded country from native.
- Index resulting from a function that compares the avg. temperature of all the countries where the specie has been and the invaded region.
- Avg. Temperature of invaded country.
- Avg. Temperature of native country.
- Sum of the trades between native country and invaded country up to event point in time.

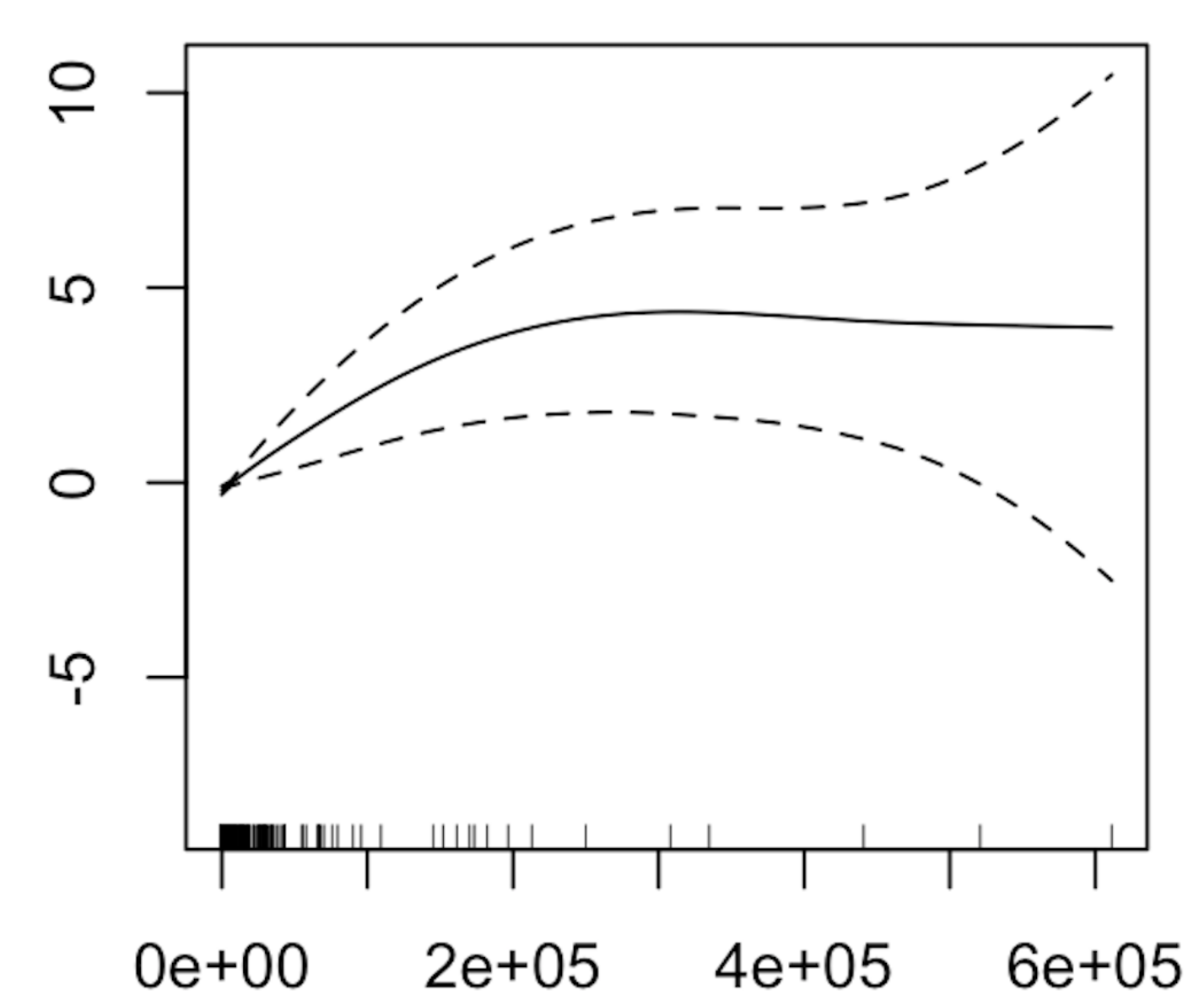
Interesting Results



Changes in **Distance from Native** does not influence the results.



Increase in **Temperature Difference** decrease invasions.



Increases in **Trades sum** increase the amount of invasion.

References

- Martina Boschi, Ruta Juozaitie, Ernst-Jan Camiel Wit. (2 Apr 2023) Smooth Alien Species Invasion Model with Random and Time-Varying Effects.
- Federica Bianchi, Edoardo Filippi-Mazzola, Alessandro Lomi, Ernst C. Wit. (30 Jun 2023) Relational Event Modeling.
- Hastie, T. J.; Tibshirani, R. J. (1990). Generalized Additive Models.